iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** VI **Month of publication:** June 2022

DOI: https://doi.org/10.22214/ijraset.2022.43933

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VI June 2022- Available at www.ijraset.com

Use of Different Depth of Footing to Determine Extra Number of Floor Required in Given SBC of Soil

Mr. Piyush Kumar Tripathi[1], Mr. Arvind Vishwakarma[2]
[1]M. Tech. Scholar, [2]Assistant Professor, Department of Civil Engineering, Oriental University, Indore (M.P.), India

Abstract— The construction of residential and commercial buildings has increased dramatically over the past two decades. A significant number of these buildings have been built in the central region such as Indore, Bhopal, Ujjain and others, and many more are planned or under construction. There are a number of design features that can significantly affect the design, including because the weight of a building increases with height, and thus the bearing capacity supported by the foundation can increase with the soil. Because the parameters vary from place to place or from different regions of the earth. These parameters need to be analyzed and evaluated. In these articles optimised number of floor can be evaluating by the analysis of a residential apartment having a plinth area taken as 625 m^2. The project consist a building with plinth area of 875 sq. m. The optimization is taken by varying the different depth of foundation i.e. 1.2m, 1.9m, 2.6m, 3.3m and 4m for the constant SBC of soil. The modelling with foundation consideration is analyzed on software under the seismic response by response spectrum method with total different 05 model cases. The main aim of the project to find the number of floor required for different depth of footing with constant area in given SBC of soil under seismic zone III.
Keywords— Multi-storeyed Building, Seismic Analysis, SBC of soil, Foundation Depth, Extra Floors.

I. INTRODUCTION

The most important part of any structure is its substructure and foundation id the basic component of it. It takes on the load of the entire building, so it is important to design the building foundation correctly. The bearing capacity of the foundation and its subsidence are the main design problems. It takes a long time to determine the bearing capacity of the soil and soil settlement. The foundation is an integral part of the building; its stability determines the stability of the entire structure. It acts as a substrate through which the load is transferred to the ground or bedrock. The stability of the foundation depends on an accurate calculation based on the structural load of the building to which it is subjected, the geology of the area and the condition of the underground foundation. Foundations are divided into shallow and deep, depending on the depth to which the load is transferred from the structure to the ground. The definitions of shallow foundations vary from publication to publication. The bearing capacity issue is perhaps the most important of all aspects of geotechnical engineering. Structural loads are transferred to the foundation by load-bearing columns, walls or other load-bearing parts of the structure. The stability requirement ensures that the foundation is not loaded, and the deformation requirement ensures that the structural application is within the superstructure's tolerance. When data on soil properties (adhesion, angle of internal friction, density, etc.) is available, the Allowable Load Capacity can be calculated taking into account shear damage. A safety factor of three will be adopted.

The bearing capacity of the foundation is of paramount importance in the design of foundations. The load at which the cutting is destroyed is called the ultimate bearing capacity of the foundation. Over the past two decades, there has been a significant increase in the construction of high-rise buildings. A significant number of these buildings were built in central areas such as Indore, Bhopal, etc., and many more were planned or under construction. There are several features of high-rise buildings that can significantly affect the design of the foundation, including the non-linear increase in the weight of the building with increasing height and therefore the vertical load from the foundation. might be great. Because the parameters differ between different places or areas of the earth's crust. Their main concerns were soil capacity and foundation depth. Therefore, it is necessary to analyze the structure of the building to ensure consistency with data on soil, SBC soil, foundation depth, earthquake zones, wind parameters, etc.

II. RESEARCH OBJECTIVES

The following objectives have been decided for public building:-

A. To obtain the number of floors required for given SBC of soil for constant area of footing at different depth of footing.
B. To obtain the minimum values of nodal displacement and base shear in both X and Z direction
C. To find maximum axial forces, shear force and bending moment in column.
D. To compare maximum shear forces, bending moments in beams.

The overall work is to compare the **load required** and **load obtained** by changing the depth of footing and changing the number of floors to obtain the result showing the number of floors required for given SBC of soil for constant area of footing at different depth of footing.

III.PROCEDURE AND 3D MODELLING OF THE STRUCTURE

Earthquake analysis is carried out using a G+7 Storey building by software approach. Total 5 models are created on the software and abbreviated as Case EN-L1. To Case EN-L5 respectively shown in table 1.1 below. The analysis part consist of the effect on building under the different loads such as dead load, live load and lateral loads (earthquake) etc. into it based on software mechanism. The seismic data is taken as per the IS 1893(part-1):2016. The response spectrum analysis method is adopted for analysis of building.

Table 1: Model Description

S. No.	Buildings framed for analysis	Abbreviation
1	Using SBC of 35 Ton/sq. m. at 1.2 m depth	Case EN-L1
2	Using SBC of 35 Ton/sq. m. at 1.9 m depth	Case EN-L2
3	Using SBC of 35 Ton/sq. m. at 2.6 m depth	Case EN-L3
4	Using SBC of 35 Ton/sq. m. at 3.3 m depth	Case EN-L4
5	Using SBC of 35 Ton/sq. m. at 4 m depth	Case EN-L5

Table 2: Input details of hospital building structures for all cases

Constraint	Assumed data for all buildings
Soil type	Medium Soil
Building type	Public Building
Seismic zone	III
Response reduction factor (ordinary shear wall with SMRF)	4
Importance factor (For all semi commercial building)	1.2
Damping ratio	5%
Plinth area of building	875 sq. m
Depth of foundation	3m
Floor to floor height	GF-4 m, All floors-3.5 m each
Fundamental natural period of vibration (T_a)	$0.09*h/(d)^{0.5}$
Earthquake parameters	Zone III with RF 4 & 5% damping ratio
Period in X & Z direction	0.64 seconds
Slab thickness	128 mm (0.128 m)
Shear wall thickness	125 mm (0.125 m)
Beam sizes	0.50m x0.35m 0.45m x0.30m
Column sizes	0.60m x0.50m
Material properties	M 35 Concrete Fe 500 grade steel

Table 3: Soil profile data for selected bore hole

S. No.	Depth	Description of depth	Soil found	SBC KN/sq. m.
1	1.2 m	Bore log 1st reading	Medium soil	196.12
2	1.9 m	Average of (1) and (3)	Medium soil	343.21
3	2.6 m	Average of (1) and (5)	Medium soil	245.15
4	3.3 m	Average of (3) and (5)	Medium soil	294.18
5	4 m	Bore log last reading	Medium soil	294.18

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VI June 2022- Available at www.ijraset.com

Model description are as follows:-

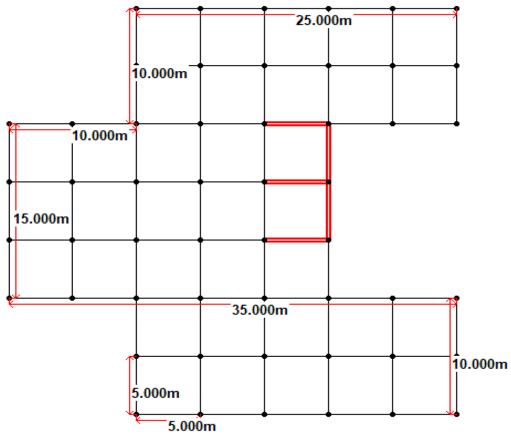


Fig. 1: Plan of all cases

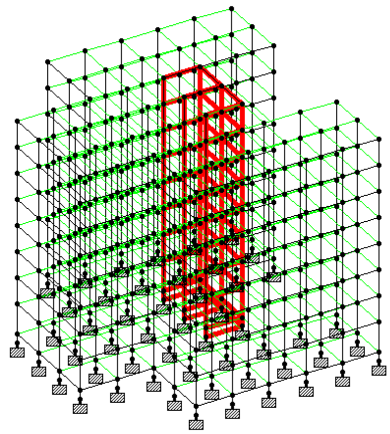


Fig. 2: 3D view of all cases

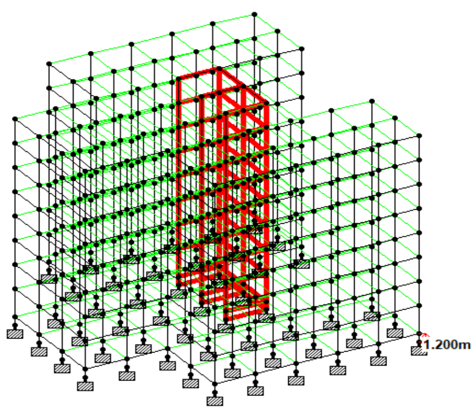


Fig. 3: Case EN-L1

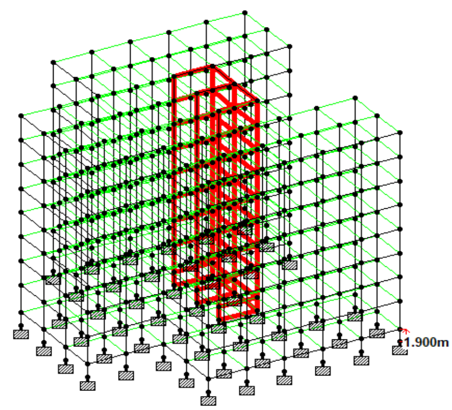


Fig. 4: Case EN-L2

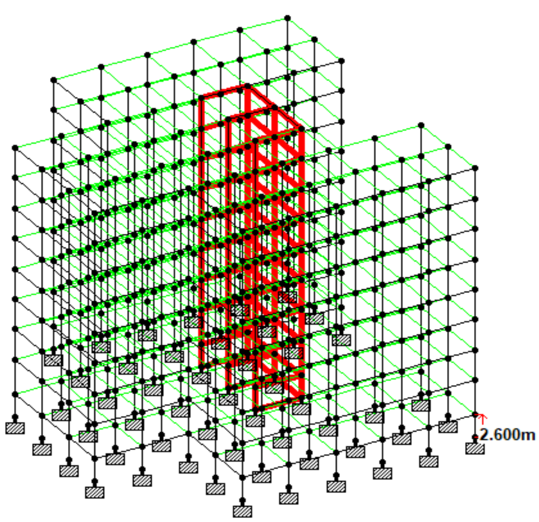


Fig. 5: Case EN-L3

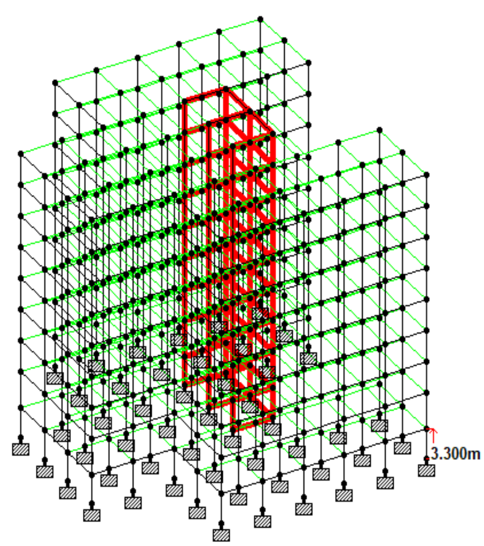


Fig. 6: Case EN-L4

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VI June 2022- Available at www.ijraset.com

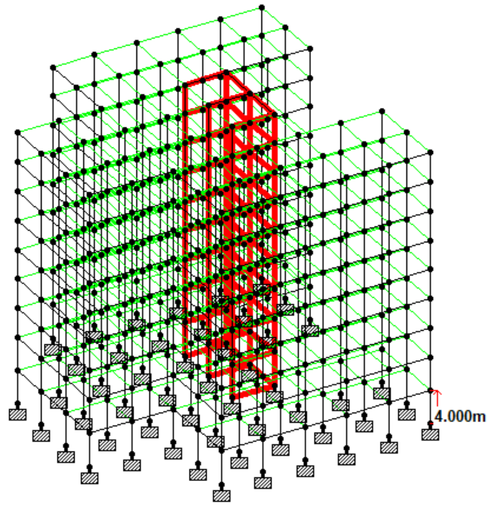


Fig. 7: Case EN-L5

IV.RESULTS ANALYSIS

The study consists of basically 5 multistorey buildings having different footing depths. To find out the number of floors required at a constant area of footing at different depths, manual analysis is also done by corresponding SBC of soil are as follows:-

Since we know that

$$SBC = \frac{Load}{Area}$$

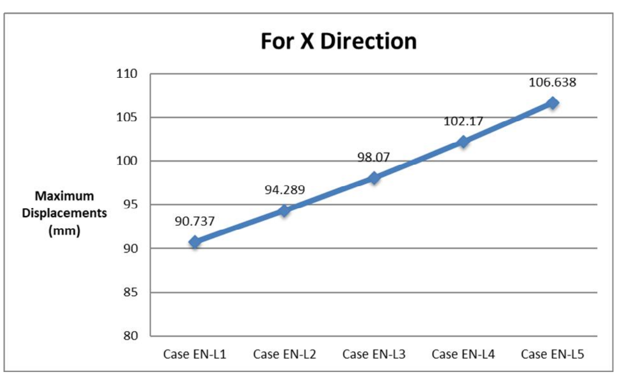
From this above equation, corresponding load required for calculation of number of floors required is given by:-

$$Load = \ SBC\ x\ Area\ of\ Footing$$

Table 4: SBC of soil corresponding to load required

S no.	Area of footing	Depth of footing (m)	SBC of soil (Ton/m^2)	SBC of soil (KN/m^2)	Load required (KN)
1	5m x 5m	1.2	35	343.21	8580.25
2	5m x 5m	1.9	35	343.21	8580.25
3	5m x 5m	2.6	35	343.21	8580.25
4	5m x 5m	3.3	35	343.21	8580.25
5	5m x 5m	4	35	343.21	8580.25

Result of each parameter has discussed with its representation in graphical form below:-



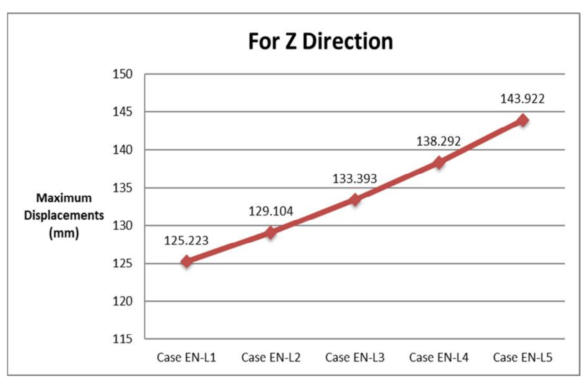


Fig. 8: Maximum Displacement in X and Z direction for all cases

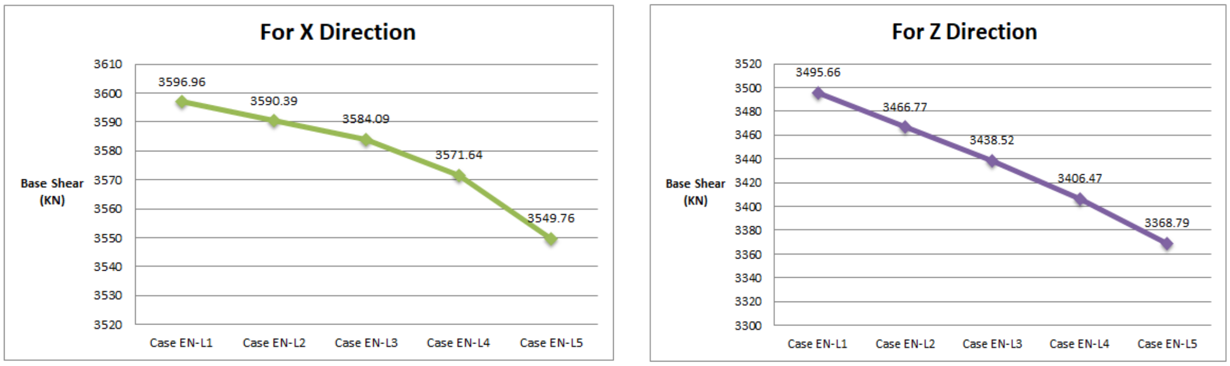


Fig. 9: Maximum Base Shear in X and Z direction for all cases

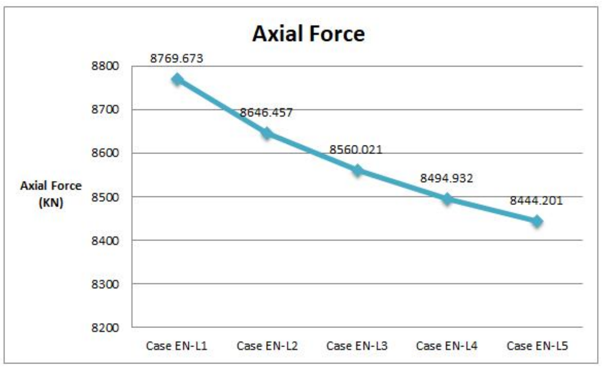


Fig. 10: Maximum Axial Force for all cases

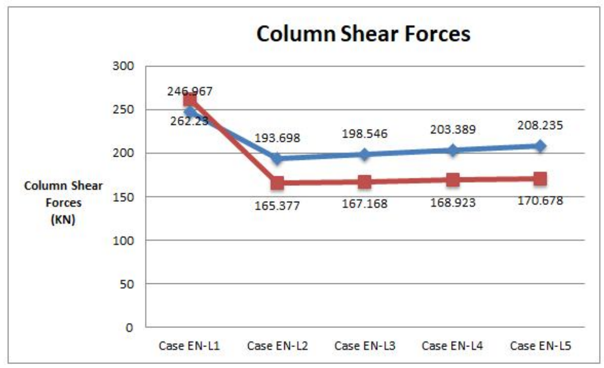


Fig. 11: Maximum Shear Forces in column for all cases

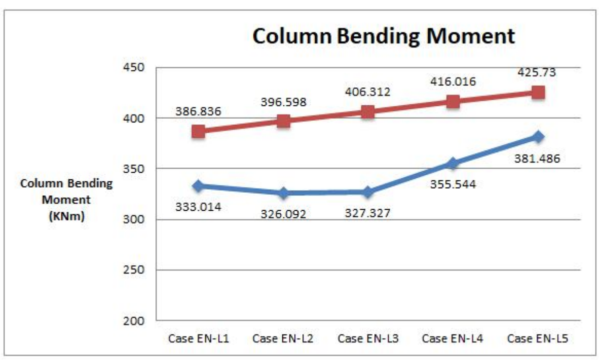


Fig. 12: Maximum Bending Moment in column for all cases

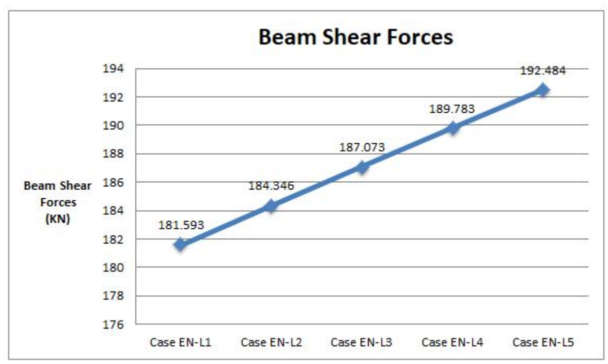


Fig. 13: Maximum Shear Forces in beam for all cases

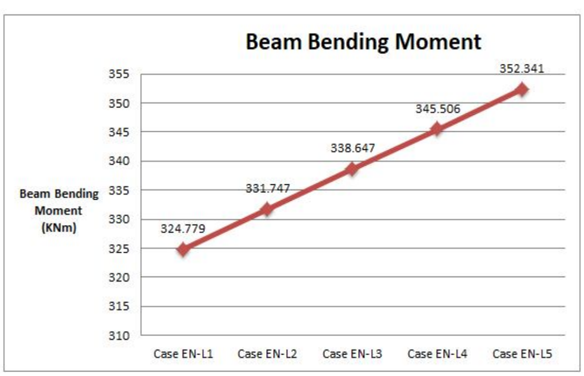


Fig. 14: Maximum Bending Moment in beam for all cases

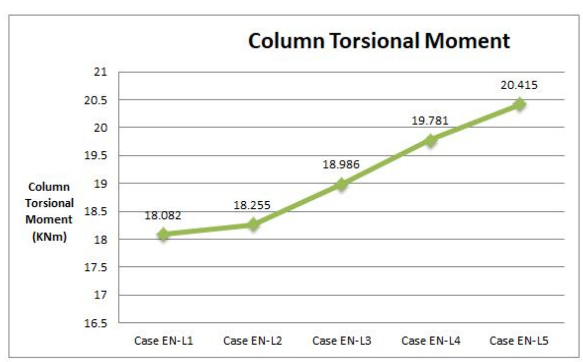


Fig. 15: Maximum Torsional Moment in column for all cases

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VI June 2022- Available at www.ijraset.com

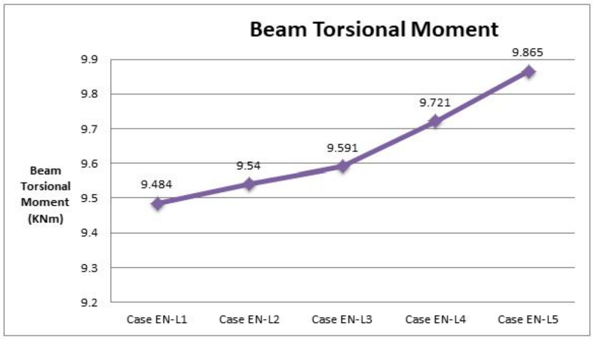


Fig. 16: Maximum Torsional Moment in beam for all cases

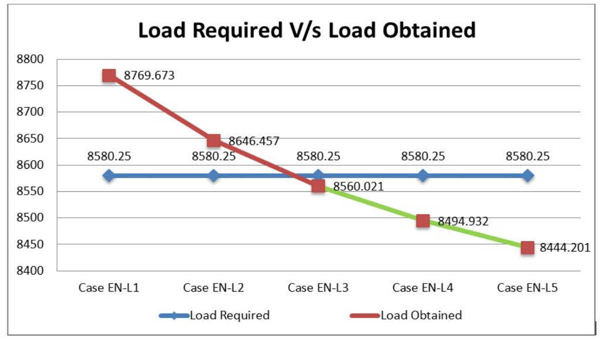


Fig. 17: Comparative representation of Load required v/s Load Obtained

V. CONCLUSIONS

After comparison of the various parameters over the building the conclusion can be pointed out are as follows:-

A. Comparing the maximum nodal displacement in X and Z direction, when depth of the foundation increases from 1.2m to 4m, nodal displacement is also increases.
B. The Base Shear values keep on decreasing as depth increases for both X and Z direction.
C. Column Axial Forces keeps on decreasing from Case EN-L1 to Case EN-L5. The same trend of graph has been observed if the value of SBC increases, the value of axial forces decreases.
D. The Shear Forces in column first decreases then it keeps on increases slowly. On comparing the Bending Moments in column, the value keeps on increasing.
E. The Shear Forces in beam keeps on increasing when the depth of the footing increases. On comparing the Bending Moments in beams, again the same trend has shown and the value keeps on increasing.
F. From Case EN-L1 to EN-L5 with selected floor level, there is increase in torsional moment values in both beams and column members.

Overall it is observed that when the depth of the footing increases from 1.20 m to 4 m, the Safe Bearing capacity of soil is selected as the maximum of 343.21 KN/m^2. Hence the load obtained is safe upto G+6 floors (Case EN-L1 to Case EN-L2) and no floors above it should be recommended. Again, the load obtained is safe upto G+7 floors (Case EN-L3 to Case EN-L5) should be recommended for selected site.

Hence as per objectives,

- The study of foundation with SBC of soil has been done on public building.
- The analysis the structure both software and manual approach has done with safe load determination.
- The model and analysis of the public building for the different depth cases of foundation has done and it has been found that from 1.2 m to 1.9 m, the public building can be made up to G+6 and from 2.6 m to 4 m, the public building can be made up to G+7.
- The cases made for constant area of 5m x5m footing at different depth study approach when plate load test carried out at a particular area in Indore city.
- The different parameters of building such as story displacement, shear force and bending moments, axial force etc. has been observed.
- The strata profile beneath the ground at a particular place has taken for analysis and design of footing.
- The no. floor required in given SBC of soil has observed for given report of SBC of soil has observed.

REFERENCES

[1] Albert Philip and Dr. S. Elavenil (2017), Seismic Analysis of High Rise Buildings with Plan Irregularity. International Journal of Civil Engineering and Technology, 8(4), 2017, pp. 1365–1375.
[2] Viktor castlenrist and stefan svensson (2016) “Methodology for preliminary design of high-rise buildings” ISRN lutvdg/tvsm--16/5210--se (1-115) ISSN 0281-6679 master’s dissertation.
[3] Priyanka soni, Purushottam Lal Tamrakar, Vikky Kumhar (2016), Structural Analysis of Multistory Building of Different shear Walls Location and Heights, International Journal of Engineering Trends and Technology (IJETT), Volume 32, ISSN 2231-5381 pp. 50-57.
[4] Pushkar rathod, rahul Chandrashekar (2015) “Seismic analysis of multistoried building for different plans using etabs” International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056p-ISSN: 2395-0072Volume: 04 Issue: 10
[5] Sagar Jamle, Nirmal Delmiya, Rahul Singh, (2020), "Efficient Use of UPV Meter: A Non Destructive Test of Concrete by Fragmentation Analysis", Journal of Xi'an University of Architecture & Technology, ISSN: 1006-7930, vol. 12, no. 4, pp. 3385-3394. https://doi.org/10.37896/JXAT12.04/1078

[6] N. Anand, G. Prince Arulraj (2014), Effect of Grade of Concrete on the Performance of Self-Compacting Concrete Beams Subjected to Elevated Temperatures, Springer Science Business Media New York. Manufactured in The United States DOI: 10.1007/s10694-013-0345-6, ISSN 1269-1284 pp. 1269-1270

[7] Mohd. Arif Lahori, Sagar Jamle, (2018), "Investigation of Seismic Parameters of R.C. Building on Sloping Ground", *International Journal of Advanced Engineering Research and Science*, (ISSN: 2349-6495(P), 2456-1908(O)), vol. 5, no. 8, pp.285-290, https://dx.doi.org/10.22161/ijaers.5.8.35

[8] Lu, X., Lu, X., Guan, H. and Ye, L. (2013), Collapse simulation of reinforced concrete high-rise buildings induced by extreme earthquakes. Earthquake Engng Structure. Dyn., 42: 705-723. https://doi.org/10.1002/eqe.2240

[9] P. P. Chandurkar, dr. p. s. pajgade (2013) “seismic analysis of rcc building with and without shear wall” International Journal of Modern Engineering Research (IJMER) ISSN: 2249-6645Vol. 3, Issue. 3, May - June 2013 pp-1805-1810.

[10] N R Shwetha , Naveen, Pampanna moolimani, s Naveen Kumar, mahesh sajjan, c h veeresh(2013) “Analysis and design of multi storey building subjected to seismic load using e-tabs” International Research Journal of Engineering and Technology-ISSN: 2395-0072e-ISSN: 2395-0056 Volume: 06 Issue: 06.

[11] Gagan Yadav, Sagar Jamle, (2020), "Use of Shear Wall with Opening in Multistoried Building: A Factual Review", *International Journal of Current Engineering and Technology*, (ISSN: 2277-4106 (O), 2347-5161(P)), vol. 10, no. 2, pp. 243-246. https://doi.org/10.14741/ijcet/v.10.2.9

[12] Tiwari Darshita, Patel Anoop (2012), Study of Strength and Workability of Different Grades of Concrete by Partial Replacement of Fine Aggregate by Crushed Brick and Recycled Glass Powder, International Journal of Science and Research (IJSR), Volume 3 Issue 6,, ISSN (Online): 2319-7064pp. 141-145.

[13] C. Marthong, T. P. Agrawal (2012) Effect of Fly Ash Additive on Concrete Properties International Journal of Engineering Research and Applications Vol. 2, Issue4, ISSN: 2248-9622, pp.1986-1991

[14] Akira Nishimura, Hiroshi Yamamoto, Yasuhiko Kimura, Hideki Kimura, Masashi Yamamoto, Atsumichi Kushibe (2011) Base-isolated super high-rise RC building composed of three connected towers with vibration control systems, Journal of Sound and Vibration, Volume 313, Issues 3–5, 2008, Pages 581-602, ISSN 0022-460X, https://doi.org/10.1002/suco.201100011

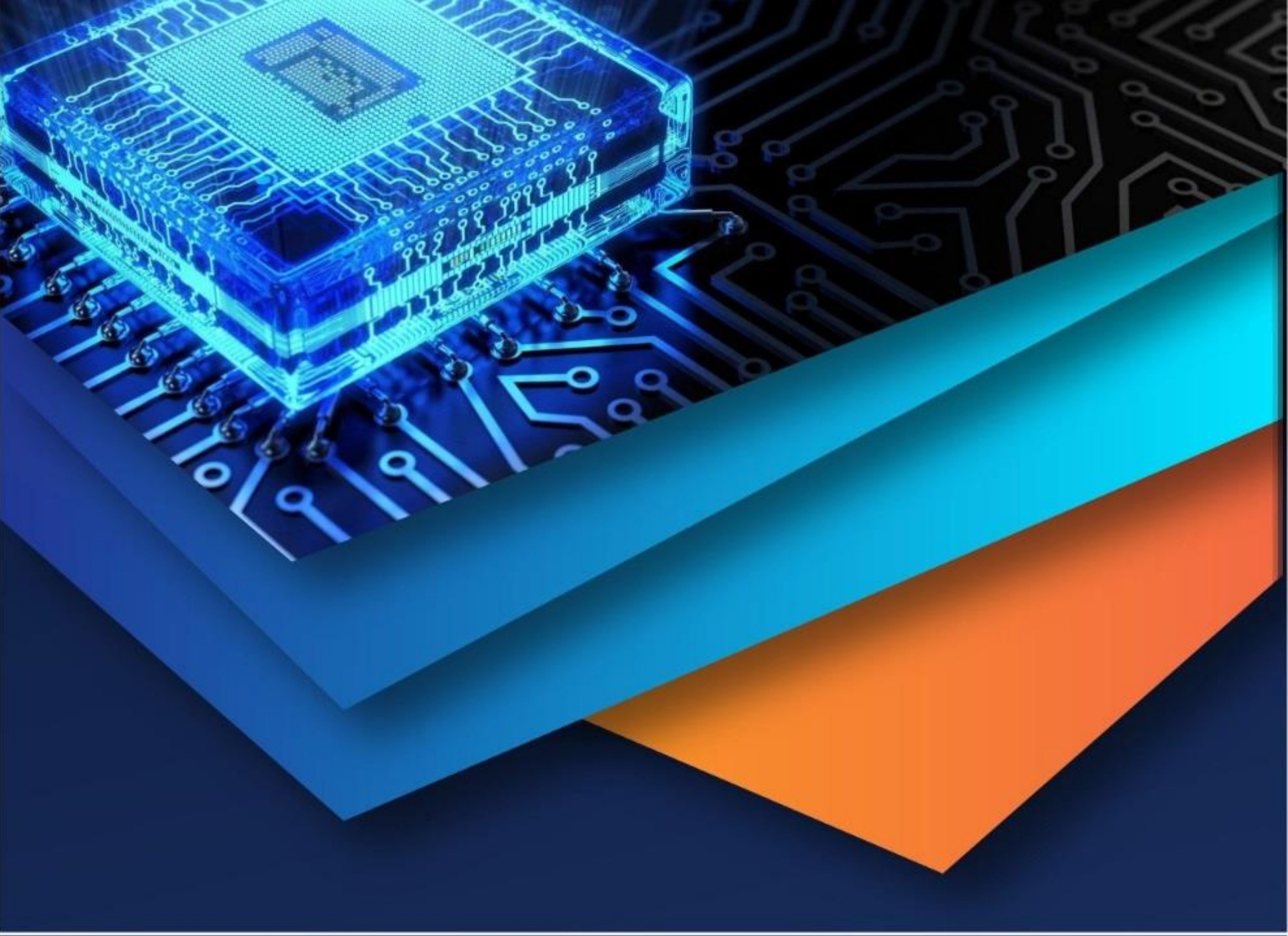
[15] t. öztürk and z. öztürk (2008), beijing, china “The effects of the type of slab on structural system in the multi-storey reinforced concrete buildings”.

[16] Q.S. Li, Y.Q. Xiao, J.R. Wu, J.Y. Fu, Z.N. Li(2007), Typhoon effects on super-tall buildings, Journal of Sound and Vibration, Volume 313, Issues 3–5, 2008, Pages 581-602, ISSN 0022-460X.

[17] Mohammad Bilal Rasheed, Sagar Jamle, (2020), "Conceptual Approach on Effect of Various Concrete Grade in Outrigger and Wall Belt Supported System: A Perceptional Review", International Journal of Advanced Engineering Research and Science, (ISSN: 2456-1908 (O), 2349-6495(P)), vol. 7, no. 5, pp. 100-104. https://dx.doi.org/10.22161/ijaers.75.14

[18] Y. Zhou, T. Kijewski, and A. Kareem, (2003), “Aerodynamic loads on tall buildings: interactive database,” Journal of Structural Engineering, vol. 129, no. 3, pp. 394–404, 2003.

[19] Wensheng LU and Xilin LU (2000), Seismic Model Test and Analysis of Multi-Tower High-Rise Buildings, the 12th International Conference on Tall Buildings, paper 0281, pp. 01-08.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429